

Engineering Specification Report

Plant Design Document Analysis

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ENGINEERING SPECIFICATION ANALYSIS

Focus Area: Entire Document

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1. Purpose and Scope of Documents:

- Defines engineering requirements and recommended practices for design of piping systems and layout for INEOS Project One, Antwerp, Belgium; to be used by FEED and EPC Contractor for onshore plants (design of process and utility piping systems) (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 1 Purpose; Section 2 Scope).
- Defines piping material class requirements (pipe class index, general notes) for Project One for use by FEED and EPC Contractor (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 1 Purpose; Section 2 Scope).
- Specifies pipe stress and pipe support criteria and requirements for stress analysis during all project stages (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 1 Purpose; Section 2 Scope).
- Covers thermal insulation requirements for piping and equipment (hot, cold, dual, acoustic, fire/CSP) for above-ground external insulation (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Section 1 Purpose; Section 2 Scope).
- Provides Basic Engineering Design Data (climatic, utilities, design lives, units, ambient parameters) governing design inputs for the project (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Sections 1-5).

2. Applicable Codes, Standards, and References:

- ASME B31.1 (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 4.2 Codes & Standards).
- ASME B31.3 (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 4.2 Codes & Standards).
- ASME B16.5, B16.9, B16.10, B16.11, B16.20, B16.21, B16.25, B16.34, B16.36, B16.42, B16.47, B16.48, B36.10M, B36.19M (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 4.2 Codes & Standards; "7650-8230-SP-100-0002_A14_Piping Matl

Spec.pdf", Section 4.2 Codes & Standards).

- API standards: API 5L, API 594, 598, 599, 600, 602, 608, 609, 610, 617, 618, 619, 623, 650, 660, 661, 688, 520 (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 4.2; "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 4.2).

- NFPA 30, NFPA 58 (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 4.2).
- PED 2014/68/EU (Pressure Equipment Directive) (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.1; "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 4.1).
- NACE standards (MR0103, TM0177, TM0284, SP0472) (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 4.2).
- ISO standards including ISO 12241, ISO 15665, ISO 14692 (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Section 4).
- Eurocode 0/1/3/8 (NBN EN series) for structural and seismic design (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 4.2; "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Sections 4-5).
- CINI (Industrial Insulation standards) (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Section 4).
- Project-specific standards (document list, e.g., 7650-8230-SP-100-0002 Piping Material Class, 7650-8230-SP-100-0016 Pipe Support Standard, 7650-8440-SP-100-0010 Pressure Testing, 7650-8230-SP-100-0007 Valve supply, etc.) (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 4.3; "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 4.3).

3. Design and Performance Requirements:

- Minimum pipe size NPS 1" (smaller only where specifically stated) and NPS 1/2", 3/4", 1½" are non-preferred; non-standard sizes (1¼", 2½", 3½", 5", 7", 9", 22") shall not be used (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.1 Pipe Sizes).
- Flange joints shall be minimised; use of flanges restricted in hydrocarbon and steam services (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.2 Pipe Flanges).
- Minimum BOP elevations: onsite 500mm, offsite 600mm (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.5 Pipe Routing).

- Minimum pipe spacing: staggered flanges minimum 150mm longitudinal clearance between flanges and minimum 25mm outside-to-outside between bare pipe/insulation; increased to 75mm for NPS 30" and above; spacing allows spectacle blind rotation (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.6 Pipe Spacing).

- **Access requirements and minimum access methods per Table 1 (valve categories and required access levels, e.g., Category 1 valves fully from grade/platform; reach/height requirements) (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.7.1 and Table 1).**

- **Valve ergonomics: Category 1 height 500mm-1.5m, reach max 300mm; handwheel clearance minimum 100mm (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.8.1 and Table 2).**

- **Line blinds types by flange class (Table 3): e.g., Class 150 figure '8' 14"; Class 300 figure '8' 10"; Class 600 10"; Class 900 6"; Class 1500 6"; Class 2500 2" and 4" (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.10 and Table 3).**

- **Vent & drain minimum sizes (Table 4): header 30" 0.5D or next size up; minimum trap take-off centreline distances (e.g., 48" 0.25" (6.4mm) (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.2 Service Limits and Pipe Wall Thickness).**

- Pipe wall thickness calculated per referenced design code and minimum thickness rules (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.2).
- All pressures and temperatures given are gauge and design unless stated (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Sections 5.3-5.4).
- Flanges ≤NPS24 per ASME B16.5; NPS30 & above ASME B16.47 Series A unless stated; ring joint flanges for class 900 and above unless stated; slip-on flanges prohibited (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.14).
- Gaskets: RTJ per ASME B16.20 when specified; flexible graphite min 95% carbon; for >480°C use Thermiculite 835/815 equivalents (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.15).

- **Bolting materials and temperature limits table with selections (ASTM A320 L7, A193 B7, B16, B8M variants, etc.) including specified temperature ranges and**

exceptions (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.16 and subsections).

- PWHT: carbon steel pipe with PWHT per ASME B31.3 where specified; PWHT requirements per pipe class and project specs (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.17 Fabrication).
- PMI required on all pressure retaining alloy components, flange bolting, welds and overlays (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.17.2).
- Cryogenic materials: austenitic stainless steels; welds qualified by Charpy impact at -196°C with average 27J/ single min 20J and lateral expansion 0.38mm (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 6.2 Cryogenic Service).
- Hydrogen service: no unions/threaded connections; flanges to be specified one class higher than process requirement with detailed flange rating substitutions; valve requirements including bellows seals for small valves, helium seat leakage test, casting examinations (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 6.5 and 6.5.1).

- Valve selection and face-to-face/standards matrix and requirements (e.g., API600/API602/API608/API609 usages and size thresholds; gear operator sizing table by valve type and class) (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Sections 5.22 and tables).

- Strainer open area minimum 150% of pipe open area; pump/compressor strainers 5D minimum to suction/nozzle (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Sections 5.13.1-5.13.3).

- Insulation: hot, cold and dual service materials, classes and selection symbology; minimum design criteria and tables for required thicknesses (Tables 5-13) for heat conservation, personnel protection, cold service, Pyrogel/Cryogel and dual service (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Sections 5, 7.8, 7.8.1, 7.8.2, 8.10, Tables 5-13).

- Insulation materials acceptance: mineral wool, alkaline earth silicate, silica aerogel, PIR, cellular glass, phenolic, foamed EPDM with usage limits and standards (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Sections 7.3-7.6; 8.2-8.8).

- Insulation finish/jacketing requirements: aluzinc generally, stainless steel for fire hazard or >600°C; sealing compound properties and installation details (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Section 6.4).

- Stress analysis: use CAESAR II (company approved version); liberal stress allowable not to be used without IPMT approval; stress range calculation rules (use greatest ΔT from listed equations); hot/cold installation temperatures and black body 65°C for uninsulated pipe for solar (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Sections 5.1, 5.6-5.7).
- Design life: piping minimum 20 years; systems operating in creep stress region design for 200,000 hours (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 5.5).
- Pipe support criteria: maximum mid-span deflection 12 mm; pipe supported on pipe shoes only (no direct on beam or rubbing bars; U-bolts not allowed); spring supports minimised; rigid supports preferred (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Sections 7.3, 7.20-7.23).
- Friction coefficients for supports: steel-to-steel 0.40, steel-to-steel round bar 0.30, steel-to-concrete 0.60, PTFE-to-steel 0.20, roller support 0.10-0.15 (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 7.1).
- Wind: consider wind on pipes $\geq 10"$ OD and at elevation $\geq 10m$; include insulation in projected area; wind shape factor $C_f = 0.9$; vortex shedding harmonic analysis where applicable (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 5.9).

- Earthquake: seismic analysis per Eurocode 8; analyse hazardous fluid lines and liquid lines $\geq 4"$ and small bore branches with large point loads; equivalent static method acceptable (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 5.10).

- Load case combinations and defined load cases (T1/T2/T3, P1, HP, D1..D3, U1/U2 seismic, WIN1-4, W/WW/WNC, F1..F9) and specific design load case matrix (Load Cases L1-L55 and combinations) for flexibility analysis (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Sections 8.2.7, 8.3).
- Flexibility criteria: detailed/formal analysis definitions and list of lines requiring DA/FA/FR (e.g., large bore $>18"$, >7000 cycles, Category M, connections to compressors, jacketed piping NPS $\geq 6"$, PRV discharge lines, lines subject to full vacuum etc.) (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Sections 9.1.2-9.1.4).
- Differential settlement provisional values (Attachment 1): pumps to piperacks 7mm; pumps to drums/tanks/exchangers 10mm; columns to piperacks 12mm; tank foundation to first pipe support 4mm (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Attachment 1).

- Transportation/module support rules: transport acceleration load cases, cord strap minimum breaking strengths by pipe size (DN50 & below 5kN; DN80-DN350 5kN-15kN; DN400-DN600 15kN; above DN600 30kN) and temporary support recommendations (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;",

Section 10 and Table 1).

- Vibration guidance: follow Energy Institute guidelines and API RP 688/688 errata; specialist consultant to be used for acoustic/flow vibration; quantitative likelihood of failure assessment for main lines and SBCs (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 11).

- BEDD climatic design data: maximum 3s gust 35 m/s (use 41 m/s for stored loading arms); design ambient max 27.2°C (99%ile), min -5.0°C (99%ile); recorded extremes max 36.7°C, min -18.3°C (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Sections 5.1-5.3 and Design Temperatures table).

- BEDD rainfall design table (Table 6) and cumulative rainfall profiles; add 10% allowance for climate change for drainage (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Section 5.4 and Table 6).

- BEDD steam utilities: S110: nominal 110 bar(g) steam; S42: nominal 42 bar(g) steam; steam design tables and temperatures (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Section 7.1 and steam tables).

- Instrument Air: header pressure normal 7 bar(g), design max header temperature 65°C, pressure dew point -40°C; instrument air hold up time on power failure 15 minutes (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Section 7.4.1).
- Nitrogen headers: N28 header normal 28 bar(g), N6 header 6.5 bar(g); header temperature up to 65°C; dew point -70°C at 7 bar(g) (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Section 7.4.3).

- Water qualities and pressures: City water pressure min 1.5 to max 3.0 bar(g); detailed City Water chemistry and Dock Water table provided (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Sections 7.3 and tables).

- Design life: piping & equipment 20 years minimum; creep service 200,000 h; other equipment life per API or tables (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Section 4 Design Life).

4. Material and Component Specifications:

- Pipe material and pipe class matrix and numerous pipe classes with flange face types, corrosion allowance, materials, ASME code and PWHT requirements listed in Attachment 1 (multiple entries e.g., A1AP3, A3AN3, etc.) (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Attachment 1.0 Pipe Class Service Index).
- Metallic pipe conforming to ASME B36.10M / B36.19M; all pipe seam welds 100% radiographed for weld joint efficiency 1.0 (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.12 Pipe).
- Pipe fittings per 7650-8230-SP-100-0009 and relevant ASTM/ASME standards (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.13).
- Flanges per ASME B16.5 up to NPS24, ASME B16.47 for 30" & above (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.14).
- Gasket, bolting, valve supply technical requirements references to project technical requirement documents (7650-8230-SP-100-0011 Gaskets; 7650-8230-SP-100-0012 Bolting; 7650-8230-SP-100-0007 Valves) (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 4.3 Project Standards and Section 5.15-5.16).

- Valve trim selection guidance per API 600 Table 8 and specified valve face-to-face and manufacturing standards by size and type (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.22 and valve tables).

- Jacketed piping: core and jacket pipes assigned separate line numbers; design to include internal/external design pressure, vacuum, hydro test of jacket; spacers max span without spacers 3 m; fabrication, inspection and testing requirements and references (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.37 Jacketed Piping).
- Insulation material references and allowable materials (mineral wool, silicate wool, aerogel, PIR, cellular glass, Cryogel/Pyrogel etc.) and cladding materials (aluzinc, SS 304/316) (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Sections 5-8).
- Positive Material Identification (PMI) required for pressure retaining alloy components, flange bolting, welds and overlays (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.17.2).

- PWHT and Charpy impact requirements per pipe class and material (minimum impact energy tables and references to ASME BPVC/ASTM requirements) (From

"7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Sections 5.17.1 and 5.17).

- Valve packing groups and temperature ranges (Group A braided graphite etc.; Group B PTFE for oxygen/strong oxidisers) (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.22 valve packing table).

- Strainers: open area \geq 150% of pipe open area; pump/compressor minimum 5D between mesh and suction/inlet nozzle (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.13.1-5.13.3).

5. Loads, Allowables, and Design Data:

- Equipment nozzle allowable loads per API 610 Table 5 for pumps or manufacturer's limits; centrifugal pump minimum 5D straight at suction unless otherwise specified (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Sections 6.1.1 and 6.1.2; Section 5.2 Process Design Data reference).

- BEDD steam design pressures and temperatures: S110 ~110 bar(g) nominal; S42 ~42 bar(g) nominal; turbine and unit steam design tables given (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Section 7.1 steam tables).

- Instrument Air: header pressure normal 7 bar(g); supply temp up to 65°C; pressure dew point -40°C (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Section 7.4.1).
- Nitrogen: N28 header normal 28 bar(g); N6 header 6.5 bar(g); header temperature up to 65°C; dew point -70°C at 7 bar(g) (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Section 7.4.3).
- BEDD wind: maximum 3-second gust 35 m/s (use 41 m/s for stored loading arms); 10-min mean 25 m/s for buildings (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Section 5.1).
- BEDD climatic extremes: max recorded 36.7°C; min recorded -18.3°C; design ambient max 27.2°C (99%ile); design ambient min -5.0°C (99%ile) (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Sections 5.2 and Design Temperatures).

- Minimum corroded pipe thickness table (explicit numeric values by NPS) (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.2 table).

- Minimum insulation thickness tables (Tables 5, 6, 7, 10, 11, 12) providing explicit thicknesses by pipe size and temperature bands for mineral wool, Pyrogel, Cryogel, PIR and cellular glass (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Sections 7.8, 7.8.1, 7.8.2, 8.10, Tables 5-12).

- Wind shape factor Cf = 0.9 to be included in wind case analysis (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 5.9).
- Relief valve discharge dynamic factor = 2 for relief discharge load calculations (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 7.4).

- Friction coefficients for support modelling (explicit numeric table) (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 7.1).

- Differential settlement provisional numeric values (pumps to piperacks 7mm; pumps to drums/storage tanks 10mm; columns to piperacks 12mm; tank foundation to first pipe support 4mm) (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Attachment 1).

- Transportation cord strap breaking strength minima by pipe size (DN50 & below 5kN; DN80-DN350 5kN to 15kN; DN400-DN600 15kN; above DN600 30kN) (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 10 and Table 1).

- BEDD rain design table numeric values for durations and return periods (Table 6 e.g., 10-min 2-yr 7.7 mm, 100-yr 23.2 mm; 24-hr 2-yr 39.0 mm; 100-yr 88.4 mm) (From "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", Section 5.4 and Table 6).

6. Execution, Testing, and Quality Requirements:

- Field welds positioned to enable spool transportation; keep number of field welds to minimum; field fit welds up to 100mm straight pipe in up to three planes permitted (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Sections 5.4.1-5.4.2).

- Factory radiography: all pipe seam welds 100% radiographed for weld joint efficiency 1.0 (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.12).
- PWHT per pipe class and as specified; carbon steel PWHT per ASME B31.3 where specified (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.17).
- Pressure testing: hydrotest vent/drain provisions (hydrostatic test vents: where no PWHT use $\frac{3}{4}$ " thredolet with plug, seal weld after test; where PWHT required use weldolet with nipple, flange and blind) (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.11.2).
- Insulation inspection stages: receipt of materials; before/during application; before/during weatherproofing; after completion. As-installed thickness tolerance $\pm 3\text{mm}$ (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Section 6.5).
- Insulation documentation submittals: materials MSDS, design calculations, procedures, handling/preservation, GA and detail drawings, quality plan and inspection report (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Section 11 Documentation).
- PMI to be carried out on pressure retaining alloy components, flange bolting, welds and welding overlays (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.17.2).
- Valve gland leak test: valve glands in hydrogen service leak tested at 1.0 barg air in half-open position and bubble-tight; helium seat leakage test required (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 6.5.1).
- Strainers: permanent strainers with differential pressure instruments where specified; temporary strainers as per 7650-8230-SP-100-0018 (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.13).
- Positive Material Identification (PMI) requirements per project spec 7650-8440-SP-100-0008 (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 4.3 and 5.17.2).
- Bolt tensioning: controlled bolt tightening per 7650-8440-SP-100-0012; hydraulic bolt torquing for larger bolts; bolt length increases for hydraulic tensioners per manufacturer (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5.16.1).

7. Client Inputs, Deviations, and Open Points:

- Applicable versions of codes/standards listed are those current at effective date of contract; applicable versions listed in 7650-8820-IN-100-0002 (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 4.2 and "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 4.2).

- Contractor to submit smallbore connection specification and vibration assessment per EI AVIFF guidelines to IPMT for approval (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.3.3).
- Contractor to submit jacketed piping design/fabrication/inspection/test plans and Fabrication Plan/ITP for jacketed piping to IPMT (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 5.37.1-5.37.4).
- Contractor responsible for material selection including corrosion allowance and valve trim; Pipe Material Class Index are guidance and contractor remains responsible (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 5 General Notes; Section 5.2).
- Liberal Stress Allowable in CAESAR II may only be used with justification and IPMT prior approval, documented in Stress Analysis Report (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 5.7 Stress Range Calculations).
- Use of expansion joints is to be avoided and allowed only with IPMT approval (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Section 8.2.2 and general comments).
- Insulation proprietary combined thermal/acoustic systems require IPMT approval (From "7650-8440-SP-100-0001_A6_Insulation - Piping & Equip.pdf", Section 9.3 and notes).

- Specific final sizes, pressures, temperatures, and line lists to be taken from Project Line List and P&IDs; many tables note final sizes confirmed by process engineer (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", multiple sections; "7650-8820-SP-100-0001_A11_Basic Engineering Design Data.pdf", references).

- Where vendor/licensor allowable nozzle loads differ, contractor to obtain vendor approval and include allowable on mechanical requisitions (From "7650-8230-SP-100-0003_A3_Pipe Stress&Supt.pdf;", Sections 6.1.1, 6.2.5).
- Items listed as "Not currently anticipated" (e.g., HIC/Sour/NACE services) require IPMT notification and development if they arise (From "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Sections 6.9 and sub-sections).
- Project-specific standards and referenced technical specifications (numerous document numbers) to be used as governing documents (From "7650-8230-SP-100-0001_A6_Piping Standard.pdf", Section 4.3 and "7650-8230-SP-100-0002_A14_Piping Matl Spec.pdf", Section 4.3).

Important Note: Items listed above are extracted only where explicitly present in the supplied documents and are labeled with their originating document/section as stated.

END OF ENGINEERING SPECIFICATION ANALYSIS